Effect of Interactive Hypermedia Program on Mathematics Achievement in Relation to Locus of Control

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***Abstract*— The study aims to determine the effect of interactive hypermedia program on students' achievement in Mathematics in relation to their locus of control. The pretest-posttest control group experimental design was carried out on 100 students' i.e 50 in the experimental group and 50 in the control group. The study examined that how the technology based interactive hypermedia program endeavoured to support learning of students in Mathematics. The findings showed that technology based teaching and learning lead to better achievement in Mathematics. It also revealed that students having internal locus of control outperformed the students having external locus of control on achievement in Mathematics.**

Keywords- Interactive Hypermedia Program; Achievement in Mathematics; and Locus of Control.

I. INTRODUCTION

The process of learning mathematics is a very complex cognitive task that can be very imposing on students since it requires a lot of effort from them. Consequently, these students need a lot of motivation to cope up with the subject. It is therefore within the benefit of education to produce instructional strategies that are interesting and stimulating. Educators are now introducing various forms of software and multimedia presentation driven media into their classroom activities (Tolhurst, 1995). These creative presentation systems are producing a great deal of excitement among educators and learners. Rapid development of information technology, especially in hardware, software, and telecommunication, has increased the potential of technology in education. To take full advantage of the possibilities that modern information technology provides, learning theories must be developed and incorporated into the design of computer based learning. Hypermedia is a much more complex type of computer-based instruction which can manifest in a range of different forms. For example, many CD-ROM based programs and instructional materials delivered on the World Wide Web are examples of hypermedia systems. In contrast to the linear approach of CAI, hypermedia materials are comprised of multiple nodes containing various media forms such as text, sound, graphics and movies either individually or combined. The structure of a hypermedia system enables users to move from one node to another at will, accessing information from nodes that are more associative and are delivered in a non-linear sequence, allowing the learner greater control and interactivity (Handal & Herrington, 2003).

Research has indicated that technologies, in its many forms and applications, have a positive impact on student performance and achievement. It can also provide advantages to normal students as well as students with disabilities, those with alternative learning styles and preferences. The introduction of multimedia computer applications in everyday lives and activities has given the students, a possibility to approach information and scaffold their ideas in a variety of ways with the assistance of a familiar medium closely related to their interests and playtime activities. Sounds and images make the content of the programs more accessible to learners who sometimes find it difficult to decode and interpret solely text-based information (Dimitriadi, 1999).

As everyone knows, generally in an educational setting knowledge flows from the teacher to the student. This type of environment could cause students to withdraw. It is suggested that students take more of an active control in the learning process. It is also important to take into consideration whether students has an external or internal locus of control. By knowing the locus of control of students the teacher can plan the type or amount of reinforcements required in the class. While many factors may contribute to school achievement, one variable that is often overlooked is locus of control (Grantz, 2006). Locus of control refers to an individual's generalized expectations concerning where control over subsequent events resides (WikEd, 2005). In the context of education, locus of control refers to the types of attributions we make for our success and failures in school tasks (Grantz, 2006). Locus of control is the perceived source of control over our behavior. It influence the way we view ourselves and our opportunities (Gershaw, 1989). Rotter (1966) classified locus of control into a bipolar dimension from internal to external. Internal control is the term used to describe the belief that control of future outcomes resides primarily in oneself. In other words, people with internal locus of control believe they control their own destiny (Gershaw, 1989). External control refers to the expectancy that control is outside oneself, either is in the hand of other powerful people or due to fate/chance or luck.

Amini, Assadi & Sadeghoghli (2012) suggested that no matter to which learning style group students belong, preference for the structured hypermedia is predominant and the achievement in hypermedia environments is irrespective of the subjects' learning styles. Bayturan & Kesan (2012) demonstrated that teaching mathematics with a computer assisted instruction method increased student success significantly in mathematics lesson. Pilli & Aksu (2012) revealed that educational software Frizbi Mathematics - 4 (computer assisted instruction) was effective in increasing attitude toward mathematics and retention of mathematics skills. Mustafa and Sharif (2011) developed an adaptive e-learning hypermedia system and revealed that students taught using learning style adaptive system performed significantly better in academic achievement ($p<0.05$) than students taught the same material without adaptation to learning style .The performance of students exposed to CAI either individually or cooperatively were better than their counterparts exposed to the traditional classroom instruction (Mudasiru, 2010). Thomas (2009) revealed that all instructional strategies (i.e. direct instruction, mastery assessment via computer technology and cooperative learning groups) employed in this study improved student achievement and most of the attitudinal variable scores. Krockover (2006) studied the effects of computer-assisted instruction (CAI) versus a text mode of programmed instruction (PI), and the cognitive style of locus of control, on pre-service elementary teachers' achievement of the integrated science process skills. The results suggested that printed PI and tutorial CAI are equally effective modes of instruction for teaching internally and externally oriented pre-service elementary teachers in the integrated science process skills.

In this respect, computer assisted instruction can be considered as a fruitful endeavor to integrate science and technology and improve the quality of learning experiences (Yenice, 2003). As indicated by various researchers (Cotton, 1991; Usun,2000; and Senturk 2005) that computer assisted instruction allows learners to progress at their own pace, control their learning, participate in the learning endeavors more willingly, learn more effectively, get a richer variety of instructional materials, keep track of the learning experiences, get direct answers for their unique questions, get instant feedback regarding their strengths and weaknesses, conduct experiments which are hard to realize in real-life, and learn at a shorter time in a systematic way. Computers are usually more enjoyable and always more patient than classroom teachers.

A. *Operational Definitions*

1) *Interactive Hypermedia Program:*

The term Interactive Hypermedia Program refers to a non-sequential document composed of text, audio and video information of Mathematics lessons of 8th class syllabus of CBSE.

2) *Achievement in Mathematics*

Achievement in Mathematics was judged on the basis of summative test of 8th class syllabus based on the topic covered through hypermedia.

3) *Locus of Control*

A perception of 8th class student about the underlying main causes of events in his/her life.

II. OBJECTIVES

- To develop an interactive hypermedia program for class 8th students in Mathematics.
- To compare the effect of interactive hypermedia program and traditional teaching method with achievement in Mathematics.
- To study achievement in Mathematics in relation to internal and external locus of control.
- To study interaction effect of instructional strategy and locus of control in relation to achievement in Mathematics.

III. HYPOTHESES

- There exists no significant difference in pre-rest mean scores on achievement in Mathematics of students studying through interactive hypermedia program and traditional teaching method.
- There exists no significant difference in post-test mean scores on achievement in Mathematics of students studying through interactive hypermedia program and traditional teaching method.
- There exists no significant difference in post-test mean scores on achievement in Mathematics of students having internal and external locus of control.
- There exists no interactional effect of instructional strategy and locus of control in relation to achievement in Mathematics.

IV. METHODOLOGY

A. *Design of the Study*

In the present study, pre test- post test control group design was used. The study was carried out on 100 students of class 8th in the month of October –December, 2013. In the present study, the investigator studied the effect of interactive hypermedia program (independent variable) on achievement in mathematics (dependent variable) in relation to locus of control (classifying variable). Both the groups were assessed before and after the treatment. In the experimental group, the lessons were taught via the Interactive Hypermedia Program, while control group was taught via the traditional method.

B. *Sample*

The students and schools constituting the study group were determined on random basis. There were 50 participants in the experimental group and 50 participants in the control group. Each group comprised of 25 students with Internal Locus of Control and 25 with External Locus of Control. Random sampling technique was used to select two English medium schools (i.e. Modern New Ways Public School and Shishu Niketan Public School) of Chandigarh only. From these two school's 50 students each was selected. The students were divided into two groups i.e. one experimental group and one control group (having 50 students each) matching through multistage randomization at section levels in the school was done for selecting students with internal and external locus of control.

C. Tools Used

Following tools were used for data collection:

- An Interactive Hypermedia Program on Mathematics developed by the investigator for treatment to the experimental group.
- Traditional teaching based lessons developed by the investigator for treatment to the control group.
- Summative test on achievement in Mathematics developed and validated by the investigator herself to analyze the achievement in Mathematics of students.
- Locus of Control Scale by Pal (1980) to collect the data on Locus of Control.

D. Procedure of Study

1) Phase I (Grouping of students and Pre- Testing)

A sample of 100 students of class 8th were randomly selected from the two schools (i.e. Modern New Ways Public School and Shishu Niketan Public School of Chandigarh). In this phase firstly the sample was divided into two groups through lottery method namely, Experimental group and Control group having 50 students each. Further the students of these two groups i.e. experimental and control group were classified into two subgroups internal locus of control group and external locus of control group. This classification continued until equal number (i.e. 25 students each) of internal and external control group students were found. Before the Administration of the treatment the subjects of the study that is the experimental group and the control group were subjected to pretest to determine the level of their performances for the purpose of comparison. The means scores of the two groups were calculated and subjected to a t-test statistic to determine group equivalence between experimental group and control group at the start of the experiment.

2) Phase II (Experimental Phase- The treatment)

Experimental group was taught through Interactive Hypermedia Program and control group was taught through traditional instruction for 60 days for one hour daily by the investigator herself.

3) Phase III (Post-testing)

After completion of the instructional treatment, the final scores were obtained, pertaining to Mathematics achievement by administering the achievement test in Mathematics as post test to the students of experimental and control group.

V. Analysis and Interpretation of Results

The analysis of pre-test and post-test scores on achievement in Mathematics of experimental and control group students having internal and external locus of control are presented as follows:

A. Analysis of Achievement in Mathematics on Pre-test Scores of the Experimental and Control Groups

In order to find out whether there was a difference between the knowledge levels of both experimental and control groups during the application, the pretest scores of the two groups were analyzed via t-test. The results obtained are presented in Table 1.

TABLE I. Difference in the Pre-test Mean Scores on Achievement in Mathematics of Experimental and Control Groups

Groups	N	Mean	SD	df	t-ratio
Experimental	50	9.22	7.69	98	0.217
Control	50	8.08	6.84		

Table 1 indicates that on pre-test scores, there is no significant difference in mean scores of the experimental (Mean = 9.22) and the control group (Mean = 8.08) students in achievement on Mathematics. It could be stated that the students in the experimental and control groups had similar levels of knowledge before the experimental treatment was started**.** So, hypothesis - 1 stating that "There exists no significant difference in pre-rest mean scores on achievement in Mathematics of students studying through interactive hypermedia program and traditional teaching method" is accepted.

B. Analysis of Achievement in Mathematics on Post-test cores of the Experimental and Control Groups

To analyse the data, 2X2 analysis of variance was used to test the hypotheses related to instructional strategies, achievement in mathematics and locus of control. The mean and standard deviation of different sub groups is presented in Table 2.

TABLE II. Mean and SD of Post- test Scores on Achievement in Mathematics of different Groups

Locus of Control	Teaching Strategies					
	Interactive Hypermedia Program			Traditional Instruction		
	N	Mean	SD	N	Mean	SD
Internal Locus of Control	25	39.52	14.24	25	30.44	11.67
External Locus of Control	25	30.48	10.44	25	29.28	12.97
Total	50	34.98	13.68	50	29.88	11.67

It is clear from table 2 that the mean scores of experimental group students (M=34.98) was higher than the control group students (M=29.88). It is also evident that the students with internal locus of control had higher mean score as compared to the students with external locus of control in experimental as well as traditional settings.

1) Analysis of Variance of Post- test Achievement Scores in Mathematics

The mean of different sub-groups, sum of squares, degree of freedom, mean sum of squares and the F - ratio have been presented in Table 3.

TABLE III. SUMMARY OF 2X2 ANALYSIS OF VARIANCE ON POST- TEST SCORES ON ACHIEVEMENT IN MATHEMATICS WITH TEACHING STRATEGIES AND LOCUS OF CONTROL

Source of Variation	df	Sum of Squares (SS)	Mean Sum of Squares (MSS)	F - value
Teaching Strategies(A)	1	392.04	392.040	5.09*
Locus of Control (B)	1	529	529.000	6.86*
A X B	1	408.04	408.040	5.29*
Error within treatment	96	7394.08	77.022	
Total	**99**	**8723.16**		

*Significant at 0.05 level

VI. MAIN EFFECTS

A. *Treatment (A)*

It is found from Table 3 that the F-ratio for difference in mean gain scores of interactive hypermedia program and traditional teaching group is 5.09, which is found to e significant at 0.05 level of significance. The groups were different beyond the contribution of chance. Hence, the hypothesis- 2 stating that, "There exists no significant difference in post test scores on achievement in Mathematics of students studying through interactive hypermedia program and traditional teaching method" is rejected. So, there exists a significant difference between group taught through interactive hypermedia program and group taught through traditional teaching method in the post test scores on achievement in Mathematics. The result indicated that the performance of interactive hypermedia program is higher than that of the traditional teaching group.

B. *Locus of Control Groups (B)*

It is evident from Table 3 that the F-ratio for difference of mean of the two groups on locus of control is 6.86; which is found to be significant at 0.05 level of significance. This significant F-ratio indicates that two groups having internal locus of control and external locus of control have yielded significantly different post - test scores on achievement in Mathematics. Hence the hypothesis- 3 stating that "There exists no significant difference in post test scores in achievement in Mathematics of students having internal and external locus of control" is rejected at 0.05 level of significance.. This implies that there is significant difference between Internal Locus of Control and External Locus of Control groups on achievement in Mathematics.

C. *Interaction Effect (A X B)*

It is clear from the Table 3 that the F- ratio for the interaction between treatment and locus of control groups is found to be 5.29; which is found to e significant at 0.05 level of significance. The significant F-ratio indicates that two variables of teaching strategies and locus of control interact to produce significant effect on achievement in Mathematics. Hence the hypothesis-4 stating that "There exists no significant interactional effect of instructional strategy and locus of control on post-test scores of achievement in Mathematics" got rejected.

VII. DISCUSSION OF RESULTS

The results of the present study revealed that the interactive hypermedia program was more effective than the traditional method of teaching. It can be stated that all of the technology based opportunities increased the achievement of the students in Mathematics. In a number of studies done by Cotton, 1991; Şentürk 2005; Usun, 2000; Yenice, 2003; Thomas, 2009; Mudasiru, 2010; Mustafa and Sharif, 2011; Pilli & Aksu 2012; Amini, Assadi & Sadeghoghli 2012; similar findings were found. Krockover (2006) suggested that printed programmed instruction and tutorial CAI are equally effective modes of instruction for teaching internally and externally oriented pre-service elementary teachers in the integrated science process skills. Also, Bayturan & Kesan (2012) emphasized that the computer assisted instruction method increased student success in Mathematics.

The achievement score in Mathematics of students taught through interactive hypermedia program was significantly higher than those taught through traditional method. Further, the post-test mean scores of students taught with interactive hypermedia program was more for internal locus of control group as to the students with external locus of control group and the difference across two method of teaching was statistically significant. Also, the difference in mean scores for interaction effect of instructional strategy and locus of control was found to be significant.

The results of the study suggest that the use of interactive hypermedia program lead to better performance of students. This indicated that the educators need to provide opportunities for all students to engage in interactive hypermedia groups in Mathematics and educators are encouraged to recognize the effectiveness and benefits of this alternative approach and to structure more hypermedia lessons in their classrooms. So, that all of the opportunities provided by such technology based programmes lead to enhance the achievement of the students.

VIII. CONCLUSION

The results of the study indicated that there was a significant difference in the achievement in Mathematics of students studying through interactive hypermedia program and traditional method. Students having internal locus of control and external locus of control have yielded significantly different post - test scores on achievement in Mathematics. The results showed that Teaching strategies and locus of control interact to produce significant effect on achievement in Mathematics. The post-test mean scores of students studying with interactive hypermedia program was more for internal locus of control group as to the students with external locus of control group.

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